CHERYL KOVALSKI, DO FACOI

NO DISCLOSURES

ACOI BOARD REVIEW 2019

ANEMIA

- Hemoglobin <13 grams or
- Hematocrit<39%

ANEMIA

MCV

RETICULOCYTE COUNT

Corrected retic ct = hematocrit/45 x retic %

(45 considered normal hematocrit)

>2%: blood loss or hemolysis

<2%: hypoproliferative process

ANEMIA

- MICROCYTIC
- Obtain and interpret iron studies
- Serum iron
- Total iron binding capacity (TIBC)
- Transferrin saturation
- Ferritin-correlates with total iron stores
- can be normal or increased if co-existent inflammation

IRON DEFICIENCY

- Most common nutritional problem in the world
- Absorbed in small bowel, enhanced by gastric acid
- Absorption inhibited by inflammation, phytates (bran) & tannins (tea)

CAUSES OF IRON DEFICIENCY

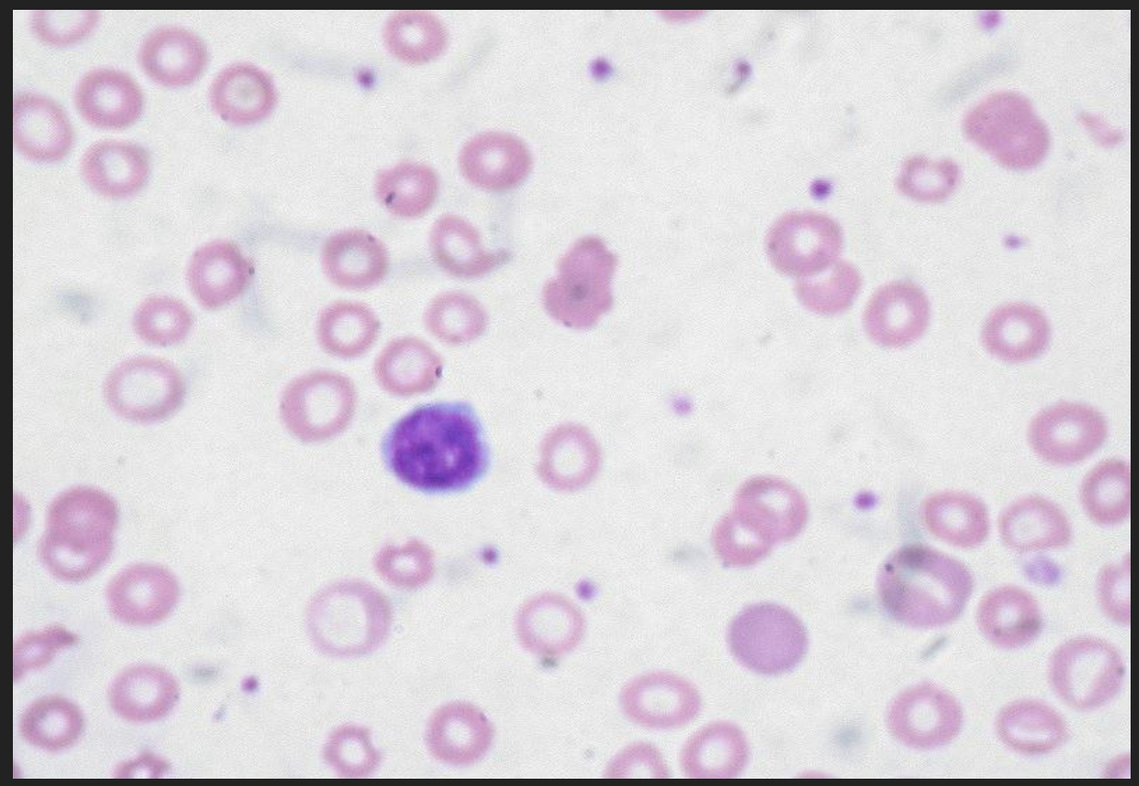
- Blood loss – most common etiology
- Decreased intake
- Increased utilization-EPO therapy, chronic hemolysis
- Malabsorption – gastrectomy, sprue

CLINICAL MANIFESTATIONS OF IRON DEFICIENCY

- Impaired psychomotor development
- Fatigue, Irritability
- PICA
- Koilonychiae, Glossitis, Angular stomatitis
- Dysphagia

IRON DEFICIENCY LAB FINDINGS

- Low serum iron, increased TIBC
- % sat <20



MANAGEMENT OF IRON DEFICIENCY

- MUST LOOK FOR SOURCE OF BLEED: ie: GI, GU, Regular blood donor
- Replacement:

1. Oral: Ferrous sulfate 325 mg TID until serum iron, % sat, and ferritin mid-range normal, 6-12 months
2. IV

TEXT

SIDEROBLASTIC ANEMIAS

Diverse group of disorders of RBC production characterized by:

1. Defect involving incorporation of iron into heme molecule
2. Ringed sideroblasts in bone marrow

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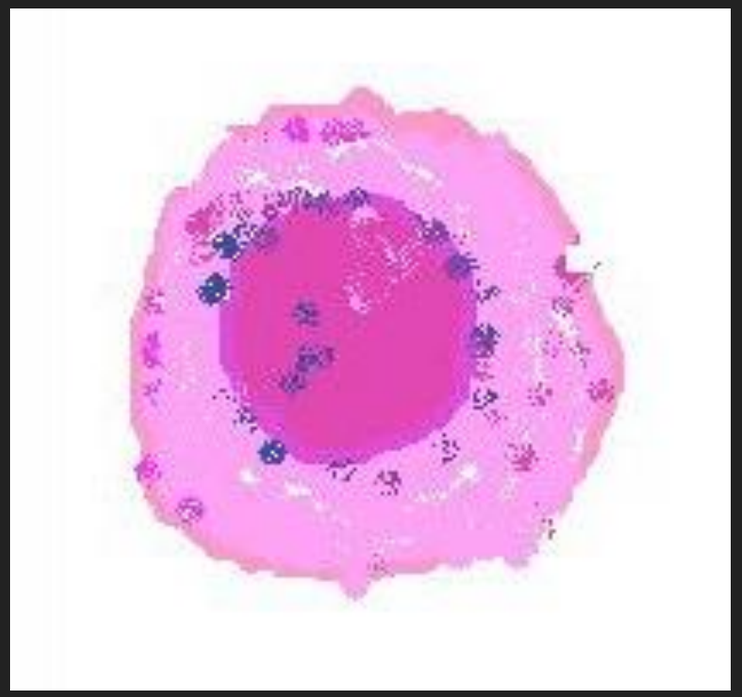


CLASSIFICATION OF SIDEROBLASTIC ANEMIA

- ACQUIRED IDIOPATHIC –one of the MDS categories
- REVERSIBLE – alcohol, INH, chloramphenicol
- LEAD POISONING – autonomic & motor neuropathy, abdominal pain

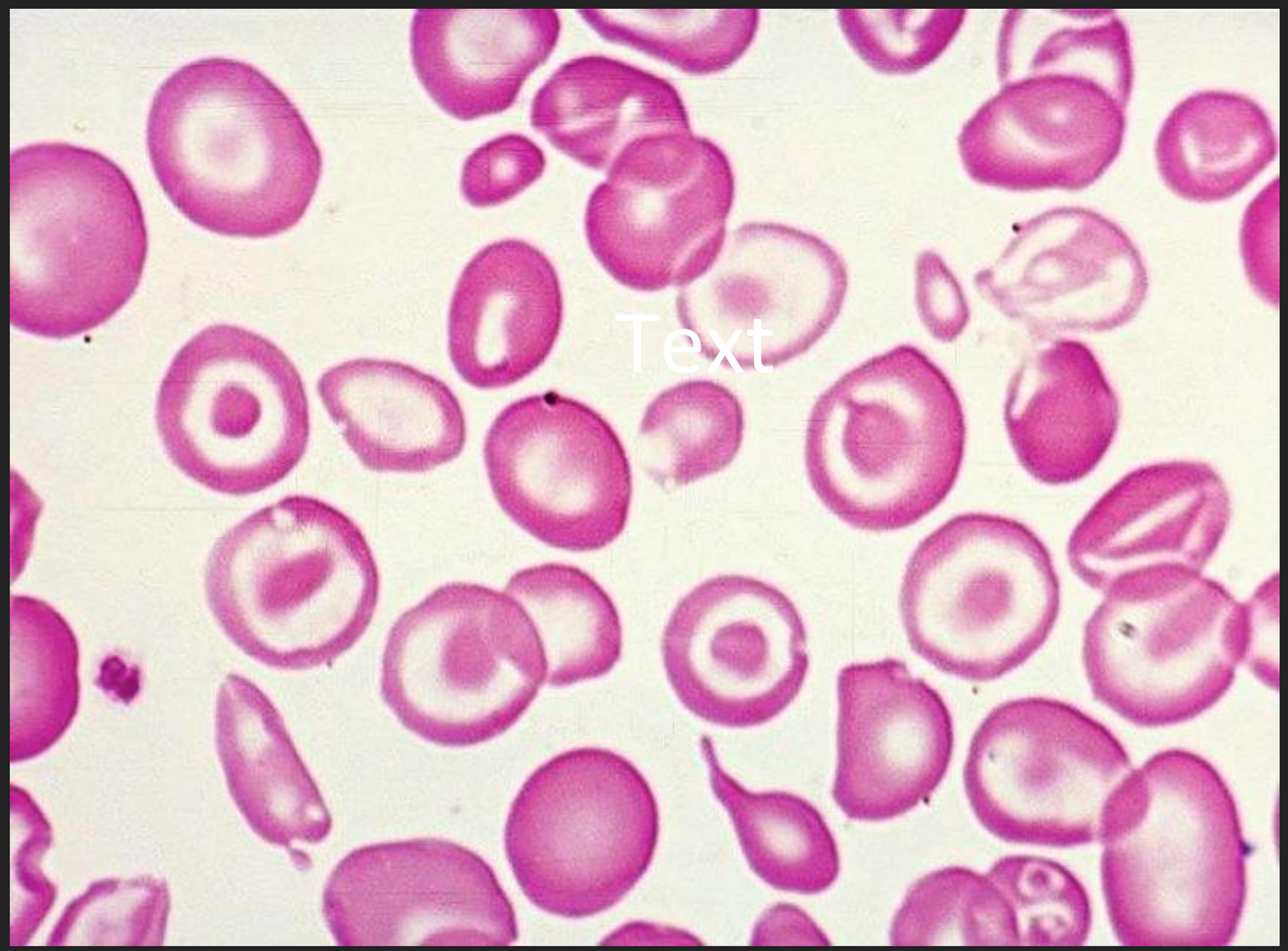
THERAPY OF SIDEROBLASTIC ANEMIA

- SUPPORTIVE
- PYRIDOXINE
- ALLO BMT
- EPO

THALASSEMIA

- Perhaps man's most common genetic disorder
- Beta Thal – decreased synthesis of beta globin chain mostly caused by point mutations, resulting in relative excess of alpha globin chains, dx-Hg electropheresis
- Alpha Thal – decreased synthesis of alpha globin chains mostly caused by gene deletion resulting in relative excess of beta globin chains, dx-Alpha thal gene probe

THALASSEMIA



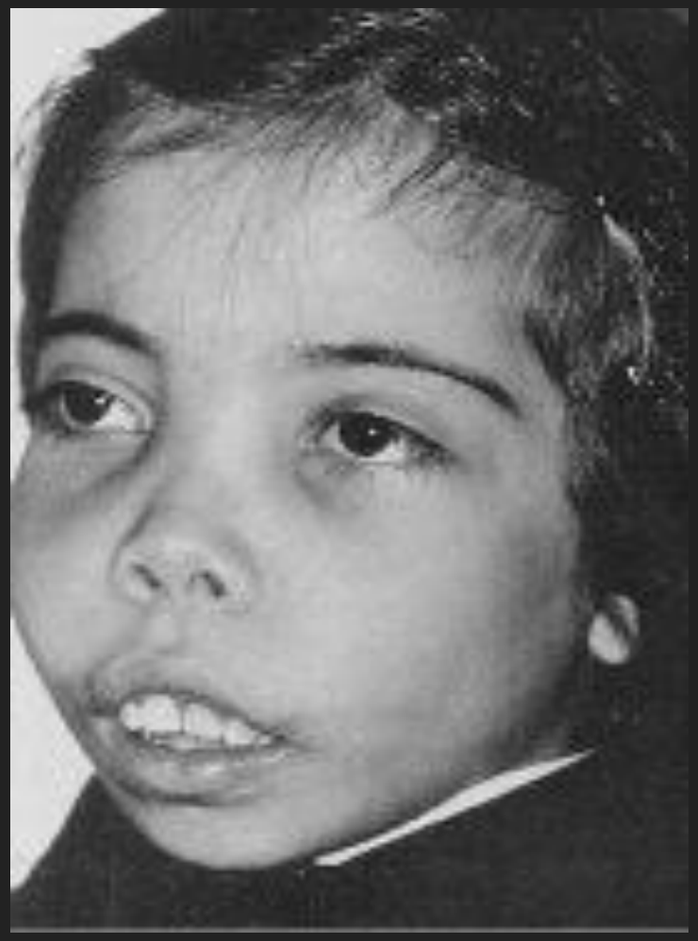
CLINICAL CLASSIFICATION OF B-THALASSEMIA

- B-Thalassemia trait (B-thalassemia minor): uncomplicated heterozygous B-Thal. Microcytosis, hypocromia +/- mild anemia, elevated hemoglobin A2 >3.5%.
- B-Thalassemia intermedia: many different genotypes, microcytic anemia-may need transfusion, high Hg F
- B-Thalassemia major (Cooley's anemia): homozygous or compound heterozygous B-thal; transfusion dependent, bone disease, pulmonary hypertension, iron overload
- genotype-phenotype correlations often difficult to make: 100s of mutations, frequent interactions, role of other modifying genes and environment

BETA THALASSEMIA: COMPLICATIONS

If transfusion dependent, best if managed in thalassemia center

- Pulmonary hypertension
- Thromboembolism
- Heart Disease
- Endocrinopathies
- Bone Disease
- Liver Disease
- Growth Retardation/Skeletal changes



ALPHA THALASSEMIA

- Silent carrier: heterozygous a+ thal; 3 of 4 alpha genes present and functional; +/- mild microcytic anemia
- Trait: 2 of 4 alpha genes present and functional; +/- mild microcytic anemia; Hb Barts (gamma 4) in 2-10% newborns
- Hemoglobin H Disease: genotype a-/- -; 20-40% Hb Barts in newborns; 5-40% Hg H(Beta 4) in adults; hemolysis of varying degrees, microcytosis, splenomegaly ineffective erythrocytosis, iron overload
- Hemoglobin Bart's Hydrops Fetalis: Homozygous alpha 0 (- -/- -); no functional alpha globulin genes: Hb Barts, eclampsia in mother, stillbirth, erythroblastosis in infant

THALASSEMIA

BIGGEST MISTAKE:

Treated with iron without benefit of iron studies

NORMOCHROMIC NORMOCYTIC ANEMIA

ANEMIA OF CHRONIC DISEASE

Hypoproliferative anemia

- Decreased red cell survival
- Impaired EPO production
- Impaired marrow response to EPO
- Impaired mobilization of iron
- Inflammatory response to underlying disorder

ANEMIA OF CHRONIC DISEASE

- Chronic nonhematologic conditions:

  Infectious

  Malignant

  Inflammatory

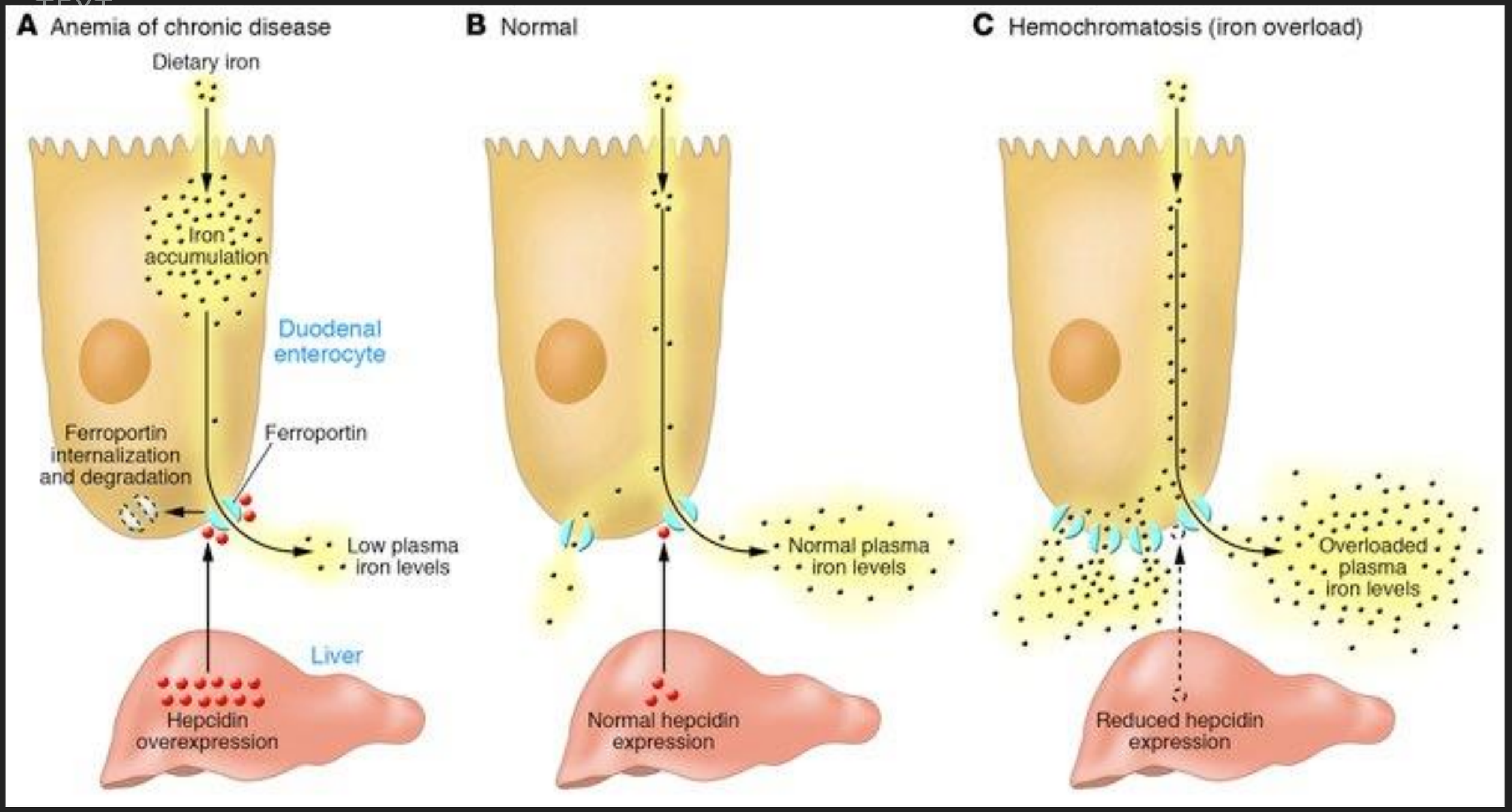
  Traumatic

ANEMIA OF CHRONIC DISEASE: DIAGNOSIS

- Exclude other etiologies of anemia

- Confirm hypoproliferative anemia

- Low serum iron despite increased iron stores in bone marrow & macrophages



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ANEMIA OF CHRONIC DISEASE: THERAPY

- Most are self-limiting and need no specific treatment
- Treat the underlying disorder
- Correct any coexistent deficiency
- Selected patients may benefit from EPO

MACROCYTIC ANEMIA

- Characterized by abnormal nuclear maturation of red cell precursors
- B12 Deficiency: consider if <300
- Folic Acid Deficiency
- Chemotherapy
- MDS
- Monoclonal protein

B12 ABSORPTION

- STOMACH: Acid, pepsin

  Parietal cells

  Intrinsic factor

- DUODENUM

- TERMINAL ILEUM

CAUSES OF B12 DEFICIENCY

- Dietary lack
- Inadequate proteolysis of B12

  - H2 Blockers, PPIs

- Deficiency of intrinsic factor

  - Gastrectomy, H2 Blockers

  - Pernicious Anemia

- Associated autoimmune disorders: hypothyroidism , Hashimoto’s, vitiligo, diabetes, Addison’s disease

CAUSES OF B12 DEFICIENCY

- Metformin
- Infections: HIV, H. pylori
- Blind loop
- Diphyllobothrium latum
- Intestinal malabsorption
- Congenital disorders
- Nitrous Oxide inhalation
- Pancreatic insufficiency

SYMPTOMS OF B12 DEFICIENCY

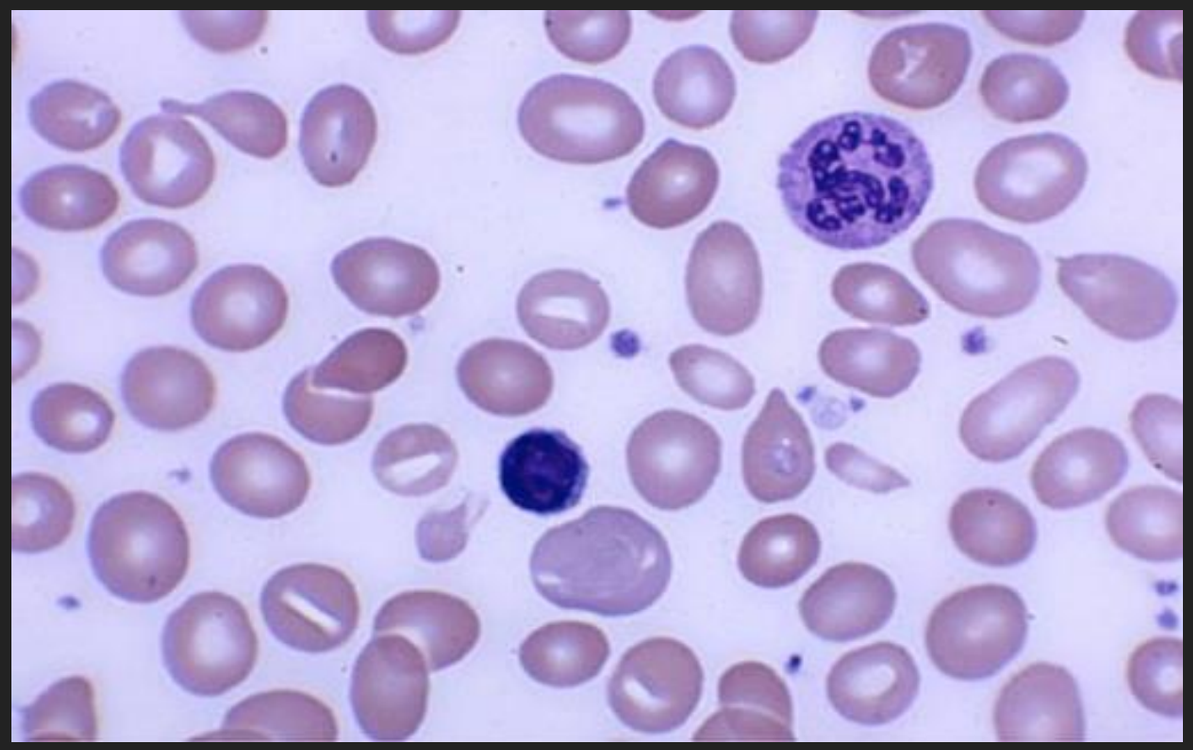
- Brain and cranial nerves-dementia, personality changes, psychiatric disorders, disturbances in taste & smell, optic nerve abnormalities
- Peripheral neuropathy-parethesias, sensory disturbances, diminished vibration and position senseAutonomic dysfunction
- Myelopathy affecting:

  posterior columns: acroparesthesias, sensory disturbances, incoordination, ataxia, diminished vibration, position

  lateral columns: weakness, spasticity

DIAGNOSIS

- Neuropsych symptoms can predate hematological changes.
- Serum B12 level is standard diagnostic test but may not accurately reflect tissue levels
- Hyperlobated WBCs



B 12 DEFICIENCY

- Methylmalonic acid and homocysteine levels elevated
- Antibody testing to diagnose PA:

  anti-parietal cell ab

  anti-intrinsic factor ab

TREATMENT

- Oral- becoming the replacement mode of choice; includes sublingual
- IM or SQ
- Nasal, expensive
- Prophylactic for gastric or ileal resection

CAUSES OF FOLATE DEFICIENCY

- Dietary deficiency, can evolve in months
- Increased requirements
- Intestinal malabsorption
- Drugs that interfere with folate metabolism

DIAGNOSIS OF FOLATE DEFICIENCY

- SERUM FOLATE
  -May normalize after 1 meal
  -May be low normal with true folate deficiency
- RBC FOLATE
  -Normal or borderline in 60% pregnant pts
  and 30% alcoholics with true folate deficiency

TREATMENT

- Folic acid 1 mg po daily is usually adequate

-Maintenance Rx: depends on underlying disorder

-Prophylactic Rx: Pregnancy, prematurity, hemolysis, dialysis

HEMOLYTIC ANEMIA

PREMATURE DESTRUCTION OF RBC'S

Occurs by 2 different mechanisms

- Extra vascular hemolysis: RBCs prematurely removed from circulation by liver or spleen
- Intravascular hemolysis: RBCs lyse in the circulation

HEMOLYTIC ANEMIA

2 MAIN CAUSES

- Intrinsic RBC defects (inherited)
- Extra-corpuscular causes (acquired)

HEMOLYTIC ANEMIA

HEREDITARY HEMOLYTIC DISORDERS

- RBC Enzyme Defects
- RBC Membrane Defects
- Hemoglobinopathies
- Thalassemias

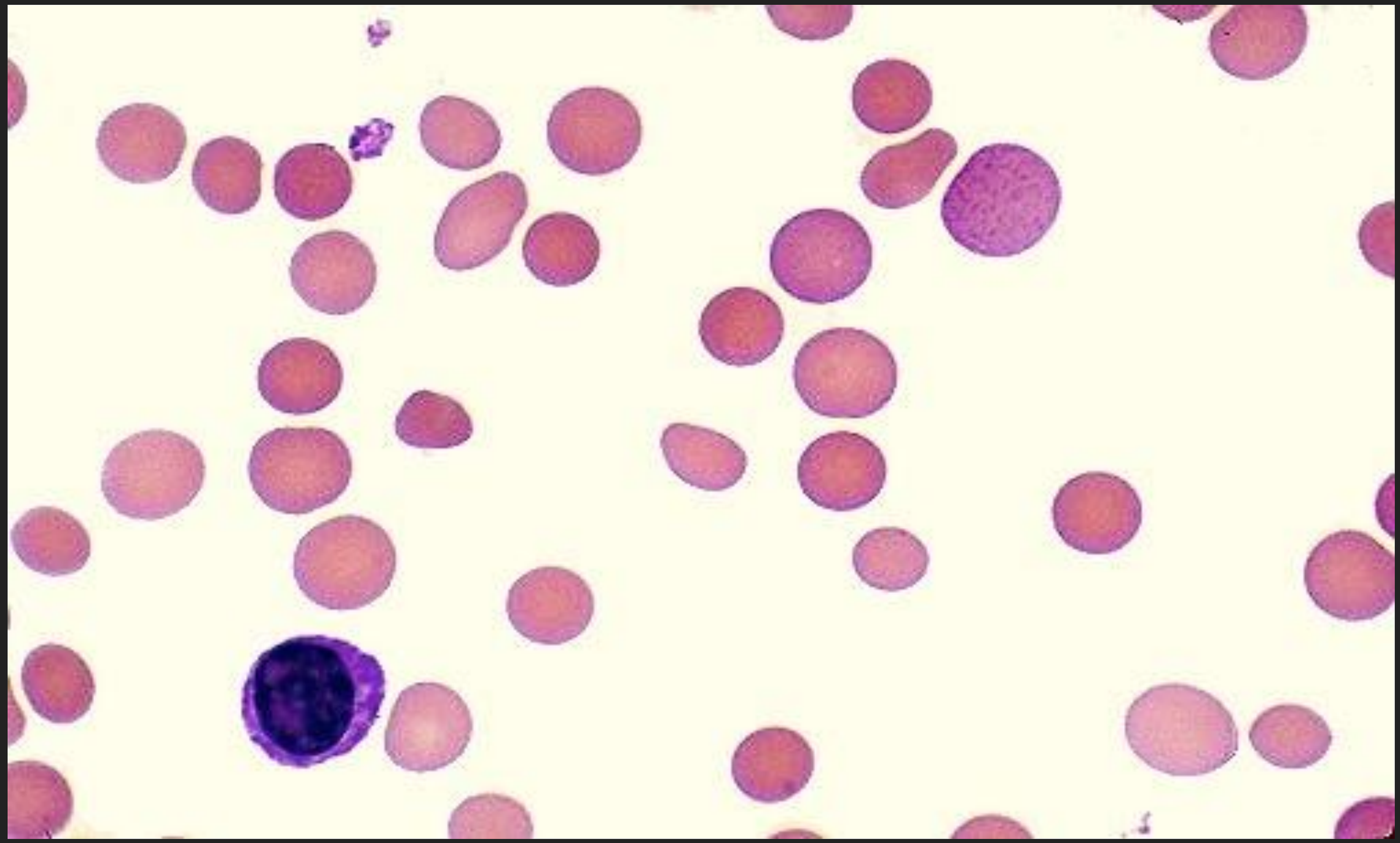
HEMOLYTIC ANEMIAS

- ACQUIRED HEMOLYTIC DISORDERS
- Immune Hemolytic Anemias
- Splenomegaly
- Microangiopathic Hemolytic Anemia
- PNH
- Direct toxic effect (malaria, clostridia)
- Spur Cell Anemia

DIAGNOSIS OF HEMOLYTIC ANEMIA

- Corrected Retic ct >2%
- Elevated indirect bilirubin
- Elevated LDH
- Haptoglobin low or absent
- Urine hemosiderin: present in intravascular hemolysis only
- Urine hemoglobin: present in severe intravascular hemolysis-urine dipstick positive for blood but no RBCs seen on micro

AUTOIMMUNE HEMOLYTIC ANEMIA



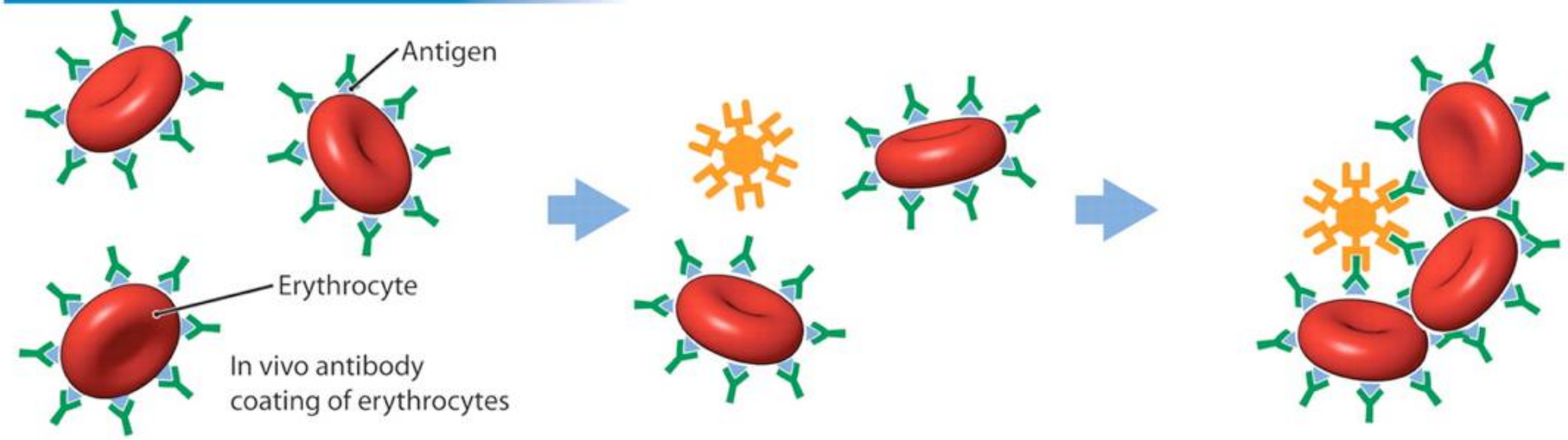
DIAGNOSIS: DIRECT ANTIGLOBULIN TEST-COOMBS

- Useful in diagnosing immune hemolytic anemia where there is antibody coating a patients red blood cells
- Done by mixing patients erythrocytes with antihuman globulin containing antibody to IgG and C3
- Test positive if agglutination occurs

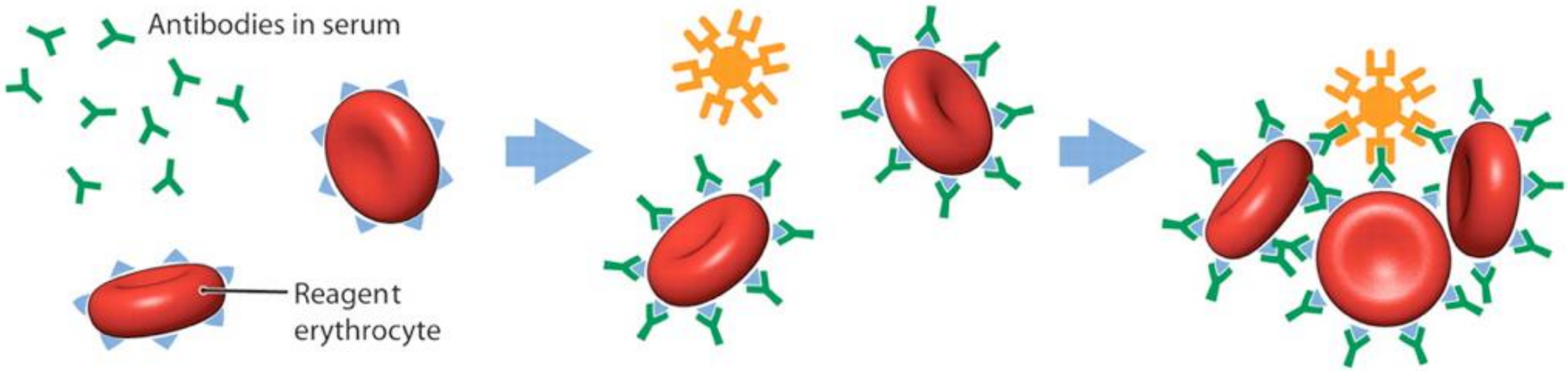
INDIRECT ANTIGLOBULIN TEST (INDIRECT COOMBS)

- Useful to detect antibodies present in patient's serum
- Helpful in detecting alloantibodies induced by prior transfusion or by fetal transfer to mother

Direct Antiglobulin Test



Indirect Antiglobulin Test



IMMUNE HEMOLYTIC ANEMIA

- 40-50% Idiopathic
- Induced by binding of antibody &/or complement to RBC membrane
- Caused by autoantibody directed against patients own RBCs or acquired alloantibody directed against transfused RBCs
- Coombs is only test that provides definitive evidence of immune hemolysis.

IMMUNE HEMOLYTIC ANEMIA

Warm-antibody Autoimmune Hemolytic Anemia

- Autoantibodies optimally reactive at 37C
- IgG present on RBC surface
- May also have C3
- Most cases idiopathic
- Can be a complication of underlying disease

IMMUNE HEMOLYTIC ANEMIA

Warm Antibody Related Diseases

- Chronic lymphocytic leukemia
- Collagen vascular diseases
- Ulcerative colitis
- Congenital immunodeficiency

TREATMENT OF WARM-REACTIVE AIHA

- Prednisone 1 mg/kg/d
- Folic acid
- Splenectomy if refractory to prednisone
- Immunosuppressive drugs
- IVIg, Rituximab
- TRANSFUSE LEAST INCOMPATIBLE BLOOD

IMMUNE HEMOLYTIC ANEMIA

- COLD ANTIBODY

  -Cold Agglutinin disease

  idiopathic

  chronic lymphocytic leukemia

  mycoplasma infection

  infectious mononucleosis

-Paroxysmal Cold Hemoglobinuria

TREATMENT OF COLD ANTIBODY AIHA

- Avoid cold exposure
- Folic acid therapy
- Treatment of underlying disorder
- Immunosuppressive agents
- Splenectomy of little value
- Rituximab
- Plasmapheresis

TREATMENT OF COLD ANTIBODY AIHA

- Transfusions of packed red blood cells:
- Compatibility testing should be done at 37˚C
- Transfuse warm blood recommended

PAROXYSMAL NOCTURNAL HEMOGLOBINURIA (PNH)

- Acquired clonal stem cell disorder-in which a mutation of PIG-A gene causes defective production of GPI Anchor Protein
- Only a portion of RBCs affected
- Defective platelets & WBCS
- Increased sensitivity of RBCS to complement mediated hemolysis

PNH: CLINICAL PRESENTATION

- May remain undiagnosed for a long period of time
- History of unexplained, chronic hemolysis, hemoglobinuria, pancytopenia & thrombotic events
- Intravascular hemolysis
- Absent haptoglobin, increased LDH, hemoglobinuria, & hemosidinuria

PNH: CLINICAL PRESENTATION

- Can be found in the setting of another specified bone marrow disorder:

  Aplastic Anemia

  Refractory Anemia-MDS

- Can be subclinical (no hemolysis)

PNH: DIAGNOSIS

Flow cytometry using antibodies directed against GPI-AP

(glucosyl phosphatidylinositol-anchored proteins)

PNH: TREATMENT

- Folic acid
- Corticosteroids
- RBC Transfusions
- Iron (can precipitate hemolysis)
- Anticoagulation with warfarin
- Eculizumab (Solaris)
- Stem cell transplant

NONIMMUNE HEMOLYTIC ANEMIA

Inherited nonimmune hemolytic anemia

- RBC membrane disorders:
  - Hereditary spherocytosis
  - Hereditary elliptocytosis
  - Hereditary stomatocytosis
- G6PD deficiency

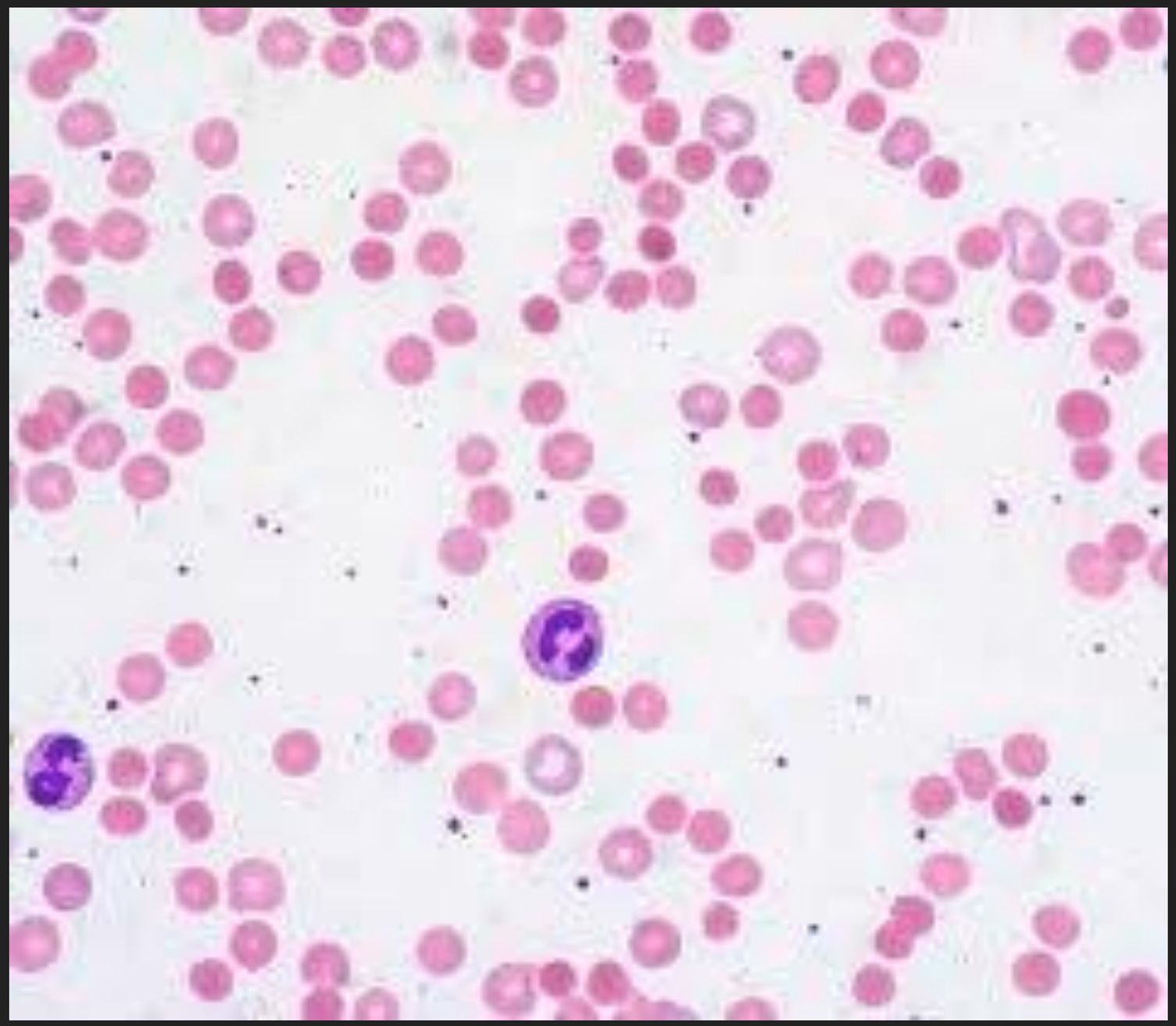
HEREDITARY SPHEROCYTOSIS

- Molecular defect in one or more of the proteins in the red blood cell cytoskeleton causing the cell to contract into a sphere shape. It has a high osmotic fragility and more prone to physical degradation.
- Osmotic fragility test

HEREDITARY SPHEROCYTOSIS

- Mild to severe hemolytic anemia
- Spherocytes on peripheral smear
- Increased osmotic fragility
- Negative direct antiglobulin test
- Aplastic crisis with viral infection
- Splenectomy is treatment of choice in severe cases

HEREDITARY SPHEROCYTOSIS



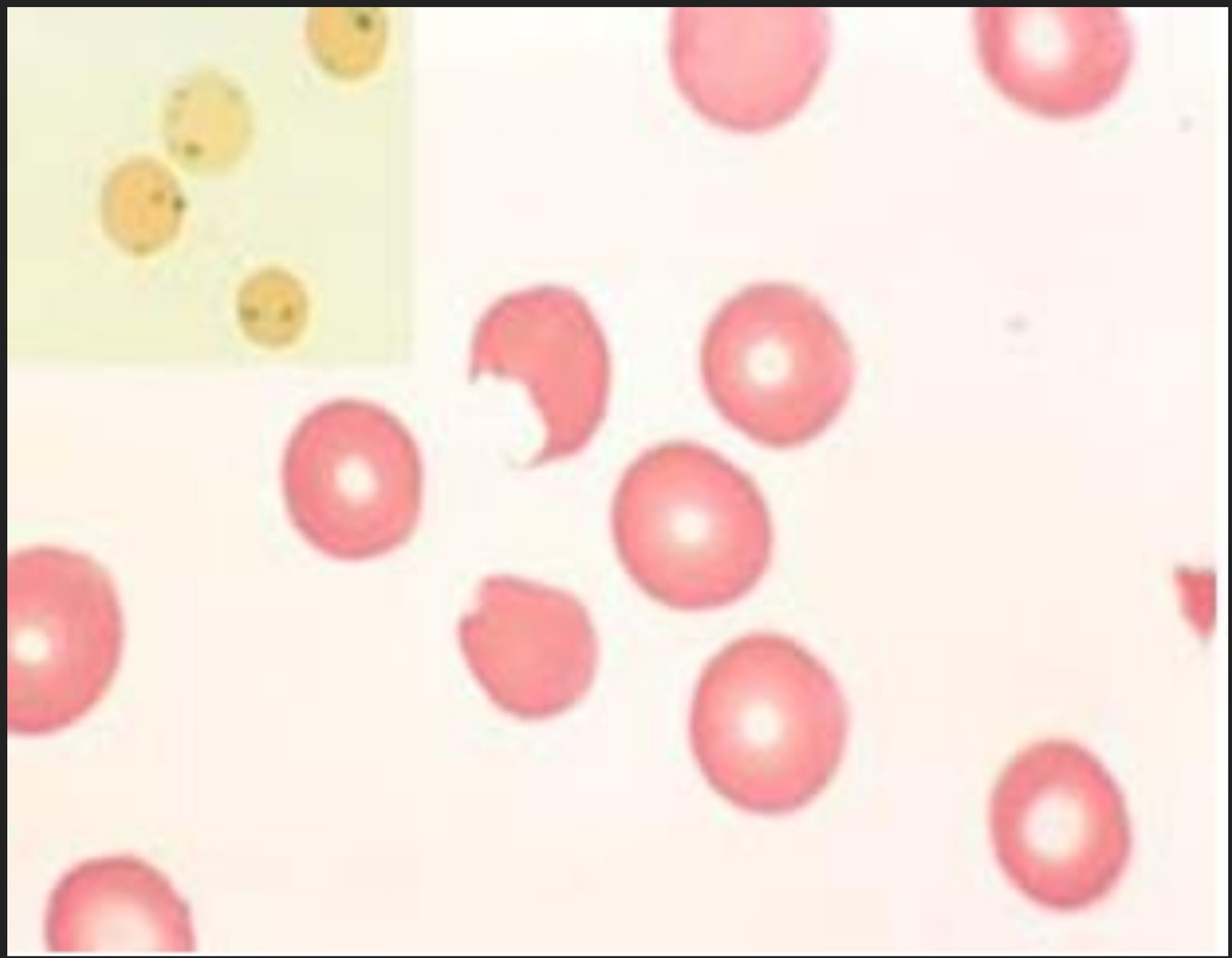
G6PD DEFICIENCY

- Most common enzyme deficiency worldwide.
- Different gene mutations cause different levels of enzyme deficiency and disease manifestations G6PD helps protect hemoglobin from oxidation upon exposure to a drug or toxin that results in the generation of free radicals
- Drugs associated with hemolysis: primaquine, sulfa, dapsone, nitrofurantoin
- Fava beans will cause acute hemolysis shortly after ingestion

G6PD DEFICIENCY

- Acute hemolysis lasts 2-4 days, self-limiting, rarely requiring transfusion
- Infections and diabetic ketoacidosis can trigger hemolysis
- “Bite” cells on peripheral smear and Heinz bodies (precipitated hemoglobin)
- Diagnosis made by level of G6PD, but may be normal in active hemolysis

HEINZ BODIES & BITE CELLS



HEMOGLOBINOPATHIES

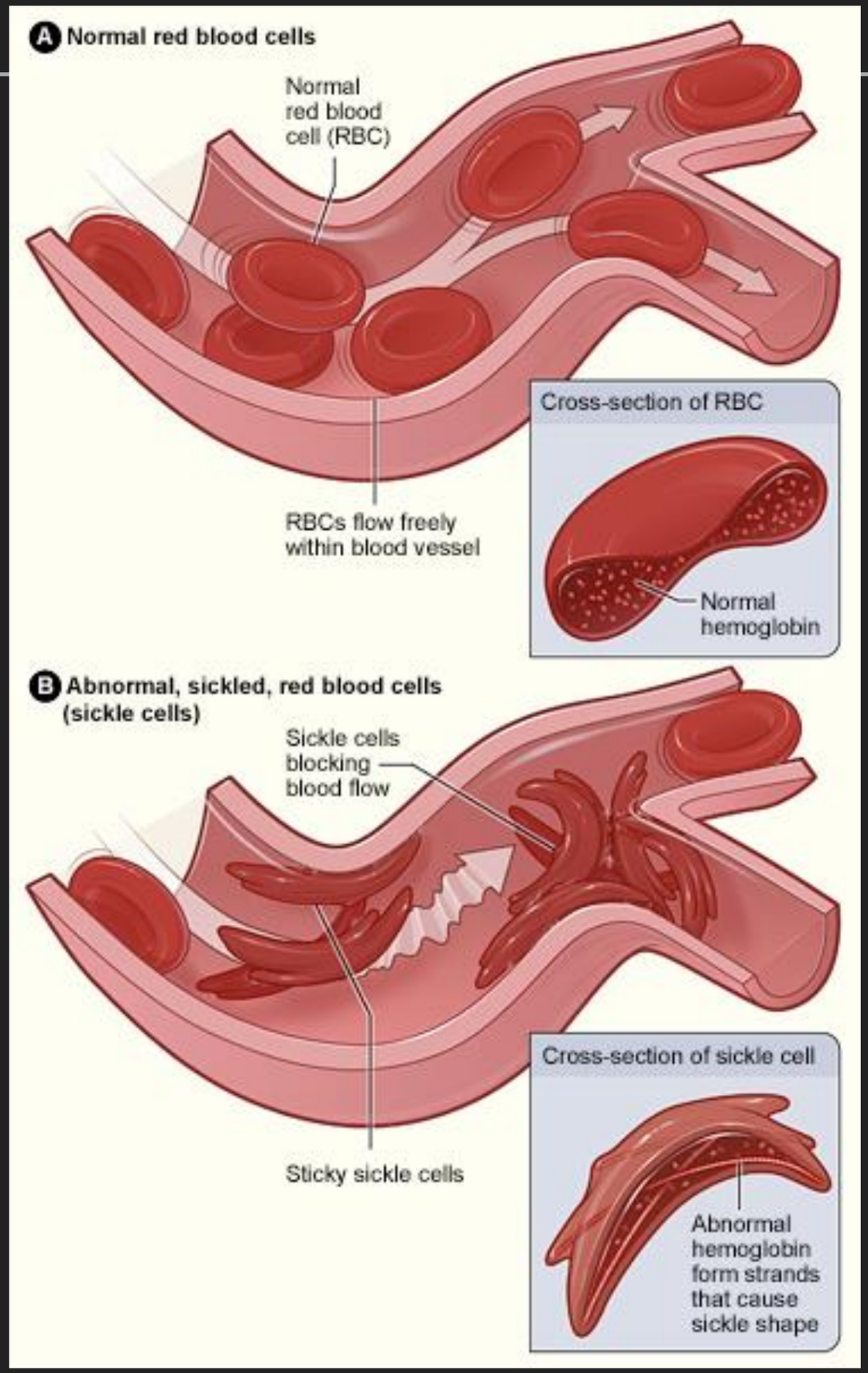
- SICKLE CELL DISEASE-the bone marrow makes sickle shaped red blood cells due to qualitative defects of globulin chain synthesis

  -HbS >50%

  -Multiple genotypes and phenotypes

  -Sickle Cell Trait is not a disease

TEXT


A Normal red blood cells
Normal red blood cell (RBC)
RBCs flow freely within blood vessel
Cross-section of RBC
Normal hemoglobin
B Abnormal, sickled, red blood cells (sickle cells)
Sickle cells blocking blood flow
Sticky sickle cells
Cross-section of sickle cell
Abnormal hemoglobin form strands that cause sickle shape

SICKLE CELL ANEMIA: COMPLICATIONS

- Painful episode-most common
- Acute chest syndrome
- Stroke (10% children)
- Osteonecrosis
- Proliferative retinopathy
- Venooclusive complications
- Infectious complications

SICKLE CELL ANEMIA COMPLICATIONS

- HEMOLYSIS

-Gallstones

-Aplastic crisis

-Osteopenia

-Anemia

-Nutritional deficiencies

SICKLE CELL ANEMIA: TREATMENT

- General medical care
- Pain management: AVOID MEPERIDINE!!
- Hydroxyurea
- Transfusion-limited, maintaining at baseline
- Stem cell transplant

APLASTIC ANEMIA

- Pure red cell aplasia
- Bicytopenia, pancytopenia
- Bone marrow failure

RED CELL APLASIA: CLASSIFICATION

- Congenital: Diamond Blackfan Syndrome
- Acquired: Idiopathic & Secondary
- Secondary:

-Hematologic malignancies

-Solid tumors

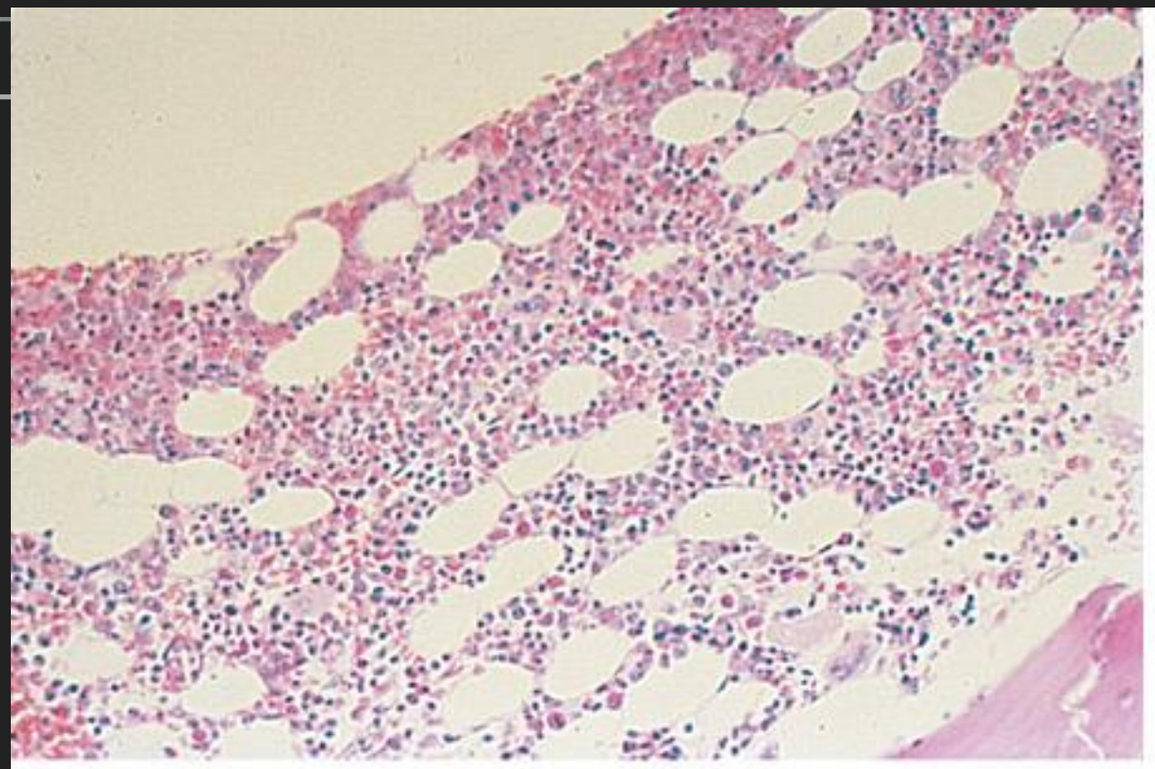
-Immunologic disorders

-Infectious diseases

-Drugs

APLASTIC ANEMIA: DIAGNOSIS

- BONE MARROW BIOPSY: 4-5 cores showing cellularity of <30%
- Flow cytometry & cytogenetics to rule out the rarer varient - hypocellular MDS



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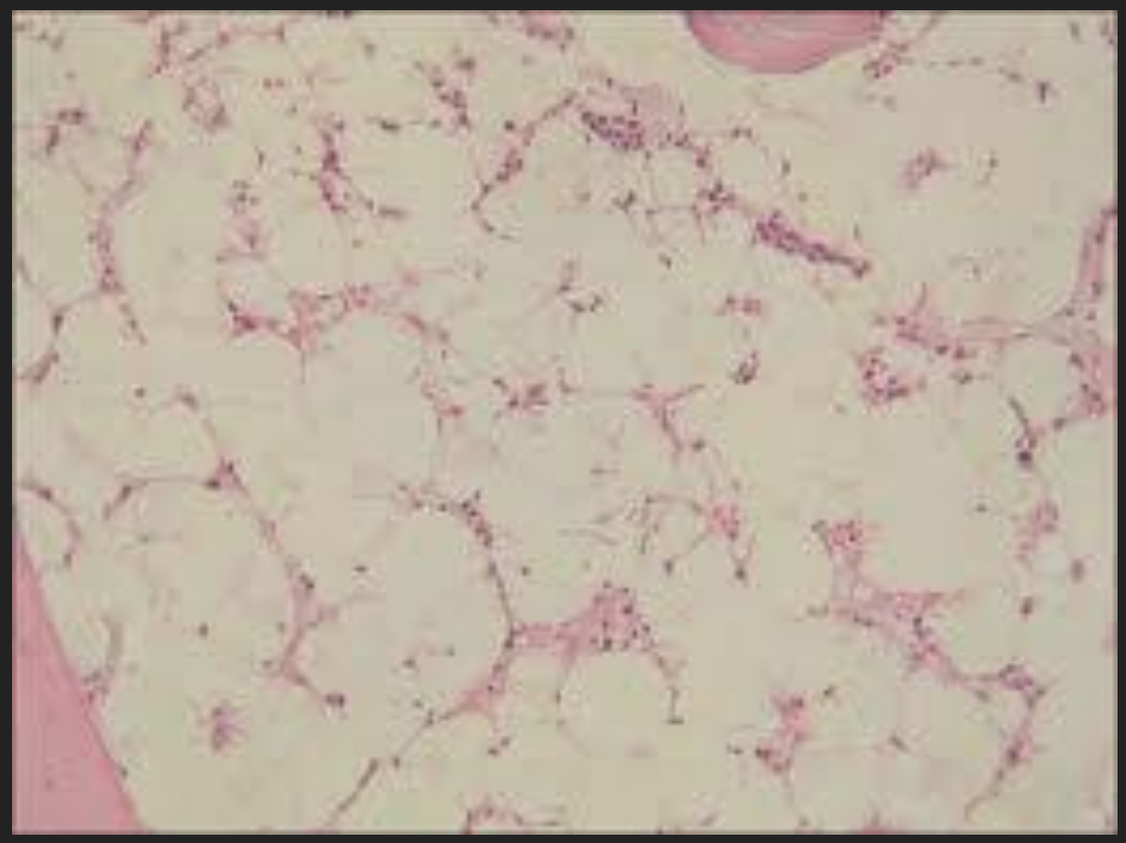

APLASTIC ANEMIA: TREATMENT

- Antithymocyte globulin (ATG) & Cyclosporin (CSA)
- Stem Cell Transplant

Hemostasis

PHYSIOLOGICAL BLOOD CLOTTING IN RESPONSE TO INJURY OR LEAK

no disclosures

Disorders of Hemostasis

- Hemophilia

- von Willebrand Disease

HEMOPHILIA

A defect in the thrombin propagation phase of coagulation

HEMOPHILIA A or B
Diagnosis

Bleeding Time	Normal
PT	Normal
APTT	Prolonged
FVIII:c or FIX:c	<1% = severe 1-5% = moderate 6-30% = mild
vWF:Ag	Normal
vWF:Rco	Normal

HEMOPHILIA
Bleeding as a function of clinical severity

Concentration of factor %

50-100: None
25-50: Bleeding after sever trauma
6-25: Severe bleeding after surgery
Slight bleeding after minor trauma
1-5: Severe bleeding after slight trauma
<1: Spontaneous bleeding mainly in joints or muscles

HEMOPHILIA: Clinical features

- Muco-cutaneous bleed
- Hemarthrosis
- Muscle bleeds
- Intra-cranial bleed
- Post-dental bleed
- Post surgical bleed

HEMOPHILIA TREATMENT

- Factor replacement

- DDAVP

- Amicar

- All patients should be cared for life long in bleeding disorder clinic

ACQUIRED HEMOPHILIA CHARACTERISTICS

- AGE: MOST >50

- BLEEDING PATTERN: More severe soft tissue bleed
  hemarthrosis less common

- INHIBITOR

- UNDERLYING DISORDER: usually none, but can be seen post partum, autoimmune disease, malignancy, drug reaction

ACQUIRED HEMOPHILIA

- Major bleeding requiring transfusion: >75%

- Death due to bleeding: >15%

- Immediate Rx with appropriate activated factor products

- Long term: Attempt suppression of inhibitor

VON WILLEBRAND DISEASE

-Most common inherited bleeding disorder presenting with: mucocutaneous bleeds, nosebleeds, bleeding with dental work, heavy menses

- Family history of bleeding

- Decreased levels of VWF

- Autosomal Dominant

- Bleeding usually mild to moderate

VON WILLEBRAND DISEASE

<u>DIAGNOSIS:</u>

- FVIII activity

- VWF antigen

- Ristocetin Cofactor

- PFA

- RIPA

- VWF Multimers

VWH Classification

Type 1: partial quantitative deficiency of VWF

Type 2: qualitative defect in VWF

Type 3: total deficiency of VWF

VWD Classification

TYPE	RIPA	Multimer Pattern	VWF:RCo/Ag
1 Partial Quantitative	decreased or normal	uniform decrease but all present	1:1
Qualitative **2A** **2B**	decreased increased	decrease large multimers decrease large multimers	decreased decreased
2M **2N**	decreased normal	uniform decrease, all present normal multimers	decreased 1:1
3 Severe Deficiency	markedly decreased	Undetectable; usually cannot visualize	N/A

VWD TREATMENT

- DDAVP

- Factor VIII concentrates that contain vWF

- Antifibrinolytics (Amicar, gel foam w/thrombin)

- Severe types should be cared for lifelong at a bleeding disorder center

THROMBOSIS

Pathological Blood Clotting

no disclosures

HYPERCOAGUABLE STAGES

ACQUIRED:

- Advancing age
- Prior thrombosis
- Immobilization
- Major Surgery
- Malignancy
- Estrogens
- Pregnancy
- Trauma
- Paralysis
- Antiphospholipid Antibody Syndrome
- Myeloproliferative disorders
- PNH
- IBD
- Nephrotic syndrome
- HIT
- Prolonged air travel
- Central venous catheters
- Obesity

HYPERCOAGUABLE STAGES

INHERITED:

- **Antithrombin III deficiency 20 fold RR**
- **Protein C deficiency 10 fold RR**
- **Protein S deficiency 10 fold RR**
- **Factor V leiden 3-8 fold RR**
- **Prothrombin gene mutation 3 fold RR**

HYPERCOAGUABLE STAGES: Who to test

Strongly Thrombophylic Clinical History

- **Age of onset <50**
- **Recurrent thrombosis**
- **Positive family h/o thrombosis, MI, CVA at young age**
- **Cerebral venous thrombosis**
- **Portal or mesenteric vein thrombosis (r/o MPD, PHN)**

Consider: VTE associated with OCPs/HRT or pregnancy
Pregnancy loss in 2nd or 3rd trimester

HYPERCOAGUABLE STAGES:
Who to not test

- Patients >50 with first spontaneous DVT
- VTE in patients with active cancer
- Elderly pts, especially post-op VTE
- Retinal vein thrombosis
- Arterial thrombosis
- Women starting OTCs with no personal or family history of VTE

HYPERCOAGUABLE WORKUP

- Prothrombin gene mutation
- Factor V Leiden (Activated Protein C resistance)
- Antithrombin III
- Protein C activity
- Protein S assay, total & free
- Tests for antiphospholipid antibody syndrome:
- Lupus Anticoagulant
- Anticardiolipin & B2-glycoprotein I antibodies

TREATMENT OF DVT/PE

- **HEPARIN**
  - **Unfractionated or LMW for 5 days**

- **WARFARIN**
  - **Start day 1**
  - **INR 2-3**
  - **Treat 3-6 months**

DIRECT ORAL ANTICOAGULANTS

- **Rivaroxaban (Xarelto)**
- **Apixaban (Eliquis)**
- **Dabigatram (Pradaxa)**

- **KNOW YOUR DRUG**

NOACs: When not to use

- Pregnancy associated with VTE
- Cancer associated VTE
- Obese patients (>275 lbs)
- Very frail patient (<100 lbs)
- Renal dysfunction-cr cl <30;
  (use with caution in cr cl 30-40)
- Patients on medicine with major interactions
- Cautious with difficult patients, ie: recurrent DVT/PE on anticoagulation
- Ensure patients comply and can acquire med

DURATION OF ANTICOAGULANT THERAPY

- First isolated, unprovoked distal DVT or proximal DVT/PE secondary to a transient risk factor: 3 months

- Second unprovoked DVT/PE: long-term?

- VTE in setting of active cancer: LMWH at least 3 mos vs long-term

DURATION OF ANTICOAGULANT THERAPY

SPECIAL SITUATIONS:
Consider indefinite anticoagulation after first event in following cases:

- **Cancer-until resolved (consider LMWH)**
- **Antiphospholipid antibody syndrome**
- **Antithromin III deficiency**
- **Protein C or S deficiencies**
- **Multiple genetic defects**

DURATION OF ANTICOAGULANT THERAPY

Criteria for long term oral anticoagulation:

- **No resolution of triggering risk**
- **Sites and severity of thrombosis**
- **Identification of a prothrombotic defect**
- **Family thrombotic history**
- **Bleeding risk**
- **Patient preference (life style, occupation) with understanding of risks vs. benefits**

THANK YOU!

Questions? 248.210.7669